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Sustainable Biomass Production for Energy Strategies in Asia: A Review for Legal and Social Aspects

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Abstract: Currently, the use of Renewable Energy (RE) has been encouraged in many countries because of its sustainability and environmental benefits. One of RE source that is considered as the largest energy potential is biomass. A study of biomass' potential availability with its current usage on a worldwide level reveals that around two-fifths of the existing biomass energy potential has been used. Most area of the world use biomass below the available potential. Only for Asia does the current use exceeds its potential. Therefore, increased biomass usage in current practice is possible in many countries. Many studies suggest an alternative solution to cover future demand for renewable energy by increasing utilisation of forest residues and waste from the wood processing industry, i.e. densified biofuels production.

In developing countries of Asia, as in industrialized ones, bioenergy will play a complementary role in conjunction with other renewables. Modern bioenergy use provides opportunities for creating jobs in rural areas, increasing the degree of comprehensive energy coverage, reducing import dependency and – through the use of more efficient technologies – reducing deforestation and energy-linked greenhouse gas emissions. Biomass production should always follow principles of sustainability. This paper specifically examines the role of biomass in developing countries of Asia; it describes some effects of biomass production for energy within social and economic contexts giving information for the existing policy.

Keywords: biomass, bioenergy, policy, social, economic, sustainability, Asia.

1. Introduction

Biomass is already the most commonly used renewable source of energy in this region and is the principal source of rural energy supplies in Asia. Over past decades, efforts have been made to develop and widen the use of biomass in order to augment existing supplies, particularly in rural areas. Governments have attempted to popularize the use of modern and efficient biomass-conversion technologies in response to the scarcity of fossil fuels and the degradation of the environment in rural areas brought about by the continuing use of firewood resulting in land clearance of forests. Biogas and efficient cooking stove programmes are being promoted. Pakistan and India are the largest users of biogas, mainly on a domestic scale, with most successful commercial projects in the region produce biogas from agricultural and processing wastes. Despite its growing importance, biomass use still faces many barriers stemming from social, institutional and some remaining economics and law factors. Many bioenergy technologies have not yet reached a stage where market forces alone can make their adoption possible. Costs are very specific depending on a large number of variables ranging from the feedstock supply management practices, types of conversion technology and social and environmental considerations. (O'Connell et. al., 2009)

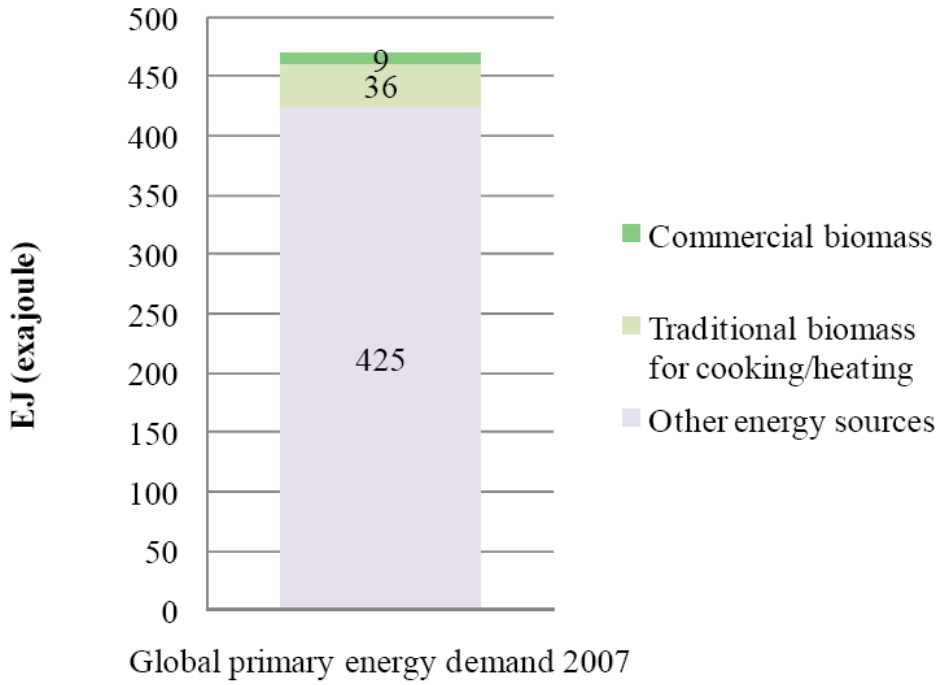

Figure 1. Contribution of Biomass to Global Primary Energy Demand of 470 EJ in 2007 (Ladanai & Vinterback, 2009)

One of the most important challenges of the century worldwide is to reduce greenhouse gas (GHG) emmissions for climate change mitigation by the replacement of fossil fuels with renewable energies such as wind energy, hydropower, solar electricity and geothermal energy. According to the German Council for Sustainable Development, sustainability means to equally consider environmental, social and economic aspects. Therefore, future-oriented management is everything that integrates ecological, social and economic system for our future children and grandchildren. One aspect cannot be achieved without the other aspect. Typical sustainability concerns include the replacement of tropical rainforest by energy crop plantations, GHG emissions

associated with biomass production and processing, as well as social issues such as land rights and labour conditions.

Biomass production can be sustainable, if the method of land management is adapted to the site and its natural conditions. The natural potential of soils should be considered and be either maintained or enhanced by the cropping and management scheme. The natural functions of the site should be regarded and necessary changes be minimized. This reduces environmental impacts (e.g. ground water pollution, GHG emissions, erosion), includes the consideration of possible impacts on natural biodiversity and facilitates long lasting utilization of the site. Habitats for site typical species should be provided coincidently on site. From economic and social points of view, biomass productions should create employment for local people, value added and assure sustainabile sufficient income for people involved. (Wichtmann & Wichmann, 2011)

On the other hand, possible negative social impacts such as food insecurity, child labour, and poverty in production countries, which are mainly developing countries, need to be considered seriously. While there could be relief on energy front, food insecurity and food price increases may aggravate the negative social impact on people. In many cases, they reflect a rosy picture which is far away from the reality. (ERIA, 2011)

This paper investigates how biomass production for energy may influence social and legal contexts and gives an example of sustainable biomass production in some of Asian countries.

2. Approach of sustainable biomass-to-bioenergy process

The principles are selected within the sustainability framework and according to the definitions of principles with the intention to provide a clear and balanced guideline for Good Practices. The intention of the principles and criteria is to provide an alternative guideline that could be used by different stakeholders when considering:

a. Bioenergy proposal or project initiation
b. Bioenergy proposal or project's feasibility report for sustainability assessment
c. Policy guidelines reviewing or decision-making process of a bioenergy proposal or project assisting
d. Ongoing bioenergy proposal or project reviewing

Finally, the principles are not exhaustive and may differ under different frameworks, projects, experts, countries or any other stakeholders' opinion. (WIP, 2006)

2.1 Social Principles

Table 1. Social principles of sustainable biomass production

No.	*Principle*	*Definition*
1.	Community participation	It considers the community participation in the bioenergy project, programme or plan since the early stages of the planning process. Local people participation is not only contributing to sustainability process but also contributes to the success of the project and will allow the community to participate in the decision-making process. Additionally, it provides a feeling of "*belonging*" and "*being recognised*" by the community.
2.	Women's participation	This principle looks for women participation in bioenergy initiatives from the early stages of the process. By involving female participation since the beginning, it allows to provide direct gender benefits and empowering women in activities directly related to them.
3.	Skills transfer (management, business and agriculture)	Transfer of skills is related to the added value of growing bioenergy crops. This includes different stages of the business cycle and it applies to the different production and scale schemes (e.g. out-growers, small, medium and large-scale). It also includes productive areas (agriculture), transformation (e.g. extraction of oil from seeds), management, and business skills (e.g. revenue and trading). (*RSB, 2009*)

2.2 Policy Principles

Table 2. Policy principles of sustainable biomass production

No.	*Principle*	*Definition*
1.	Compliance with national policies and/or guidelines for bioenergy policy in place	Where national policies or guidelines regarding bioenergy production exist, these should be followed by all stakeholders involved in the bioenergy initiative such as the proponent, the community, national and international consultants and developers, investors, NGOs amongst others. Working with the national, regional and local authorities is considered to be important especially for developers and investors to look at cross-cutting sectors (e.g. social, environment, and agriculture sectors).
2.	Compliance with local policies and/or plans in place	When working with the national, regional and local authorities it is considered important to be aware of all programmes, plans and regulations at local level. Compliance with them will strengthen the bioenergy initiative and avoid conflicts with different stakeholders.
3.	Respect lands rights and avoid displacement	The debates on land rights in developing countries (mainly in Asia) led to this principle to be considered by communities, governments and investors. Displacement needs to be avoided as far as possible or regulated by the decision of (local) authorities after thorough studies with the involvement of all affected stakeholders. Adequate compensation and further studies for relocation need to be included according to international practice. (*WIP, 2006*)

2.3 Economic Biomass Potential in the Asian Region

The global primary production (GPP) of biomass is comparable to 4,500 EJ of captured solar energy per year. Only 5 % of this large energy amount would have been required to cover 50 % of the world's energy needs in 2006. Another prerequisite for determining the future potential of biomass energy is the availability of land. The world's total land area is 13.2 billion hectares, of which 0.19 % is used for growing crops for biofuels, which accounts for 0.5 % of the global agricultural land.

The potential of modem biomass for development and industry is increasingly recognized in the South East Asian region, being the traditional energy source in rural areas. Its full potential has not yet been fully exploited because of the problems affecting development and utilization such as a lack of proper political framework, socio-cultural barriers, techno-economic constraints, environmental impacts and the absence of effective marketing strategies to achieve sustainable markets. Many biomass technologies have not reached a stage here market forces alone can make the adoption of these technologies possible. (*Van Dam et. al., 2010*)

Table 3. Biomass Consumption by Different Fuels (Victor D.G., 2002)

	Animal dung	Crop residues	Fuelwood
Bangladesh	13%	61%	25%
Bhutan	0%	0%	100%
Cambodia	0.02%	2%	98%
China	3%	54%	43%
India	14%	23%	63%
Indonesia	0%	6%	94%
Laos	0%	0%	100%
Malaysia	0%	46%	54%
Maldives	0%	0%	100%
Myanmar	0%	1%	99%
Nepal	7%	4%	89%
Pakistan	19%	22%	60%
Philippines	0%	36%	64%
Sri Lanka	0%	2%	98%
Thailand	0%	30%	70%
Vietnam	0%	29%	71%

For wider diffusion of biomass technologies, a set of policy measures and implementation strategies suited to various national situations would need to be evolved to address marketing and financial issues. Such a political framework should consist of a clear vision of the role of biomass in future energy supply options with a commitment at a high level to the achievement of the role envisaged. To facilitate the implementation of policy options, certain fundamental issues need to be understood and internalized. This could leads towards improving marketing infrastructure (such as financing, service, etc.) and developing longterm markets.

The biomass industry is moving from a technology-driven phase to a market-led phase. Future studies on biomass energy systems devote efforts to commercialization and marketing which are essential for wider scale use. At the regional level, co-operation between countries through networking mechanisms is needed to promote biomass

development and use. To combat short-term financing problems, especially for small-scale bioenergy projects, the industry must have the ability to develop a self-sustaining business structure through market development. This would involve support from both the public and private sectors to establish an appropriate financing scheme, aimed at the deployment of renewable technologies along with the establishment of a local industry and training infrastructure.

From a sustainability point of view, the sustainable energy crop potentials will realistically be towards the lower end of the mentioned range of 200–600 EJ per year. The latest studies of energy crop potentials on abandoned land and studies committed to sustainable biomass production show lower bioenergy potentials. (Kessler, 2007)

These studies estimate that biomass could contribute anything from below 100 EJ per year to above 400 EJ per year to the future global energy supply in 2050. This shortage of future bioenergy potential is mainly caused by uncertainty regarding future land availability and future yield levels in energy crop production. Moreover, most of the literature studies only provide preliminary estimations of the future availability of forest wood and of residues from agriculture and forestry. In sum, only rough estimations are possible of the sustainable bioenergy potential in the future global energy supply.

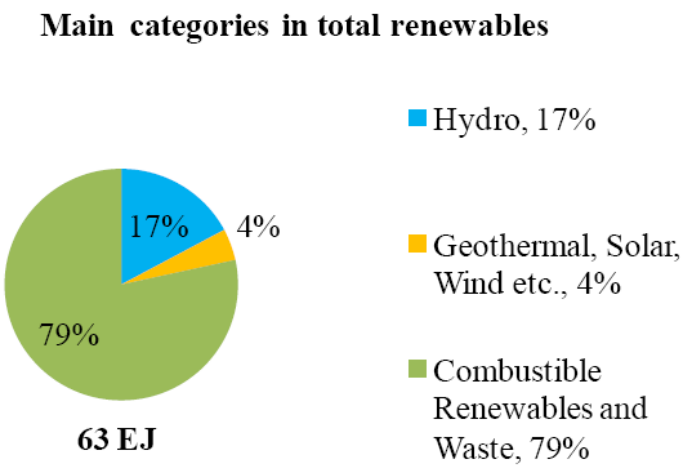

Figure 2. Share of biomass in total global renewables in 2006 (Ladanai & Vinterback, 2009)

3. Legal Framework

3.1 Future Biomass Energy Potential and Its Possible Constraints

According to the water, energy and food security nexus approach, the expansion of the bioenergy sector should interact sensibly with other land uses and ecosystem services, such as food and fodder production, soil and nature conservation, biodiversity and carbon sequestration. The assortment of energy plants, accompanied by certain crop sequences, can alter the carbon sequestration potential of an area, which is an important factor in the climate protection chain. In addition to the production of energy crops, the alteration of the soil and the associated ecosystem services may also influence the carbon sequestration balance of an area. (*Vlosky & Smithhart, 2011*)

In general, the following constrain bioenergy potentials:

a. Population growth, consumption per capita and lifestyle (decisive for the amount of area reserved for food production)
b. Land availability (areas used for reforestation, areas lost by soil degradation, areas reserved for nature protection)
c. Future crop yield increases under changing edaphic situations (soil moisture and climate)
d. The preservation of biodiversity and the need to expand nature reservation areas
e. Land degradation (the most important driver is soil degradation and reduced land availability)
f. Severe water scarcity (a limiting factor in terms of quality and quantity)

Owing to these six constraints, it is difficult to estimate the impact of biomasss production expansion as an advantageous option for the energy sector. (*Bhattacharya et. al., 2003*)

3.2 Key elements of legal regulatory framework of biomass production

Regulatory tools for the promotion of bioenergy usually consist of a combination of policies and legislation including measures to encourage private investment in bioenergy industries and financial assistance to public or private investors from national, bilateral or multilateral sources. The key elements of national regulatory frameworks for bioenergy include legislation establishing institutional structures, regulating the biofuels market, creating incentives, regulating trade, introducing

sustainability certification schemes, and fostering research and development.

With respect to the establishment of institutional structures, national bioenergy legislation typically designates a state agency to be responsible for promoting the necessary investments and steering national bioenergy programmes. This may include technical committees responsible for setting of standards. With respect to newly created entities in Asian countries it is important that these agencies have sufficient technical capacities. Furthermore, efficient coordination mechanisms with other relevant state agencies need to be put in place to ensure that bioenergy policies and legislation are effectively implemented and regulation is consistent with international commitments and other government policies. Finally, broad cooperation with the civil society is necessary to facilitate widest participation and transparency in decision making. (*Wang, 2007*)

Bioenergy policies and legislation also often contain provisions on *market regulation* such as biofuel blending requirements (i.e. mandated percentage of biofuels to be mixed with conventional fuels), and fixed prices for bioenergy services (including biofuels). The regulation of blending requirements, however, should take into consideration local and national market conditions in Asian countries. (*Konishi et. al., 2010*)

Incentives are essential components of regulatory measures to encourage the production, use and trade of bioenergy. Such incentives may include exemptions from value added taxes, corporate taxes, and excise taxes. Furthermore, government financial institutions are required to provide financial services and benefits to local companies

engaged in the bioenergy sector, and incentive schemes should focus on the provision of micro-credit facilities or low-interest loans and loan guarantees to farmers for the cultivation of crops or to build their own processing facilities. Incentives in Asian countries, however, should be carefully selected to stimulate investment without creating negative socio-economic (e.g. reduced labour standards, displacement of rural communities) and environmental (e.g. deforestation, soil degradation, water depletion) impacts.

Trade regulations may include import tariffs as well as mandates for bioenergy producers to buy feedstock from local farmers. Even though such regulations may distort trade, they can serve to safeguard the creation of local and national bioenergy markets and contribute to local value creation and rural development.

Sustainability certification is an important tool to ensure bioenergy development with maximised benefi ts and minimised negative environmental and socio-economic impacts. Since the 1990s a variety of sustainability standards and certification schemes have been developed (mainly in the EU) for the production, processing and trade of biomass and agricultural products. More recently, sustainability schemes are introduced which specifically address the production and use of (liquid) biofuels. (*Zilberman et. al., 2010*)

In order to proof compliance with sustainability requirements, regulatory frameworks in Asian countries may use existing sustainability schemes such as the International Sustainability and Carbon Certification System (ISCC) originating from Germany, the

Dutch sustainability scheme (NTA 8080), the RSB (Roundtable on Sustainable Biofuels) sustainability scheme, and the RSPO (Roundtable on Sustainable Palm Oil) sustainability scheme for sustainable palm oil production. Alternatively, Asian countries may develop national sustainability schemes with specific reference to national framework conditions and development priorities.

Bioenergy regulatory frameworks often also contain provisions for ***research and development*** such as the obligation for an assignment of increased national funds. Enhanced efforts in bioenergy research and development are regarded as essential for the development of strong and sustainable bioenergy sectors in Asian countries. (*Wang, 2007*)

3.3 Policy requirements and implications

In many countries, the biggest problem is the lack of a solid political framework for the exploitation of biomass resources. Such a framework should consist of a clear vision of the role of biomass in the future energy supply option with a commitment at a high level to the achievement of the role envisaged. In addition, there must be a well-established constitutional, legal, institutional and administrative system which will translate the will of the political leadership to definite targets and set time frames to achieve the targets. The development and utilisation of biomass may then become apparent, but measures to be taken to attain the goals will first have to be defined. Such measures and policy instruments have to be administered at low cost and not be in

conflict with other government policies. Many countries of the Asia-Pacific region have no national policies to specifically promote the use of biomass energy systems which has inhibited its development. Even in China, India, Sri Lanka, Thailand and the Philippines where such policies have become part of the national energy policy, the implementation has not always been successful because of inadequate high level political will. As energy policy decisions on biomass affect the rural economy, policies to specifically promote its use should feature more prominently. The effectiveness of a policy depends on the data which are used in its formulation. (*Zilberman et. al., 2010*)

For instance, a good knowledge of the resource base of a particular energy source, its potential demand and the techno-economic parameters of the relevant conversion technology are essenfial when formulating policy on supply options. The lack of resource data on biomass residues coupled with the lack of skilled manpower has adversely affected the ability to formulate policies and translate them into strategies, plans and projects. Unlike conventional fossil fuel sources, the collection of data on biomass resources, particularly agricultural residues, and the development of energy plans involving biomass is a very complex multidisciplinary project that requires specialist knowledge. To improve the present situation, national actions through policies and activities are required. A set of policy measures and implementation strategies suited to various national situations will need to be evolved and pursued. The development of policy and planning structures to provide sustainability of rural energy supplies need continual addressing. These will vary from country to country depending

on the specific experience and situation of each country, but a number of inter-related policy issues are common.

3.4 Policy premises

Intemalisation of policy premises is necessary so that socio-economic dimensions can be properly addressed and diffusion possibilities become easier to achieve. The specific recommendation on policy that was first adopted in 1981 at the Nairobi Conference on Renewable Energy, known as the "Nairobi Programme of Action" was that national policies should give high priority to biomass as a component of overall national energy policies.

These policies should incorporate a description of the mechanism for implementing decisions in a manner that is appropriate to the interests, needs and social custom of local communities. In addition, each policy should have a well-defined objective addressing a specific issue, which may be of concern or interest to the energy sector, the general economy or the environment. These recommendations should serve as policy guidelines for the formulation of national energy plans incorporating biomass.

Such policies have been introduced and implemented in China, India, Nepal and Indonesia at national and regional levels, backed by appropriate policy instruments and institutional frameworks to enhance the development and utilisation of biomass, especially crop-residues. (*Van Dam et. al., 2010*)

4. Overview of social aspects for different scales in Asia

Furthermore, social indicators such as literacy rate, education enrolment, life expectancy, gender empowerment, etc., are relevant to the state of development of Asian countries. It is important to compare the change in social welfare as a result of activities related to biofuel production. Ideally, such comparison should be made between the actual situation "*before and after*" the activity but data and information for "before and after" scenarios were not available. As biomass production in all countries selected in the project is at its initial stage, data availability on various aspects of sustainability was a major problem.

One of the main arguments in favour of biomass production in Asia is opportunities for Asian people and economies. On the other hand, there is also serious concern about the socio-economic sustainability of biomass production. Biomass production has impacts on different levels: single persons, households, farmers, communities, regions and countries. Thereby, impacts can be positive or negative.

Food security refers to food availability and access to food. A household is considered food-secure when its occupants do not live in hunger or fear of starvation. Food security is often related to biomass production. In many cases no differences between food availability and access are made. Food availability means that sufficient quantities of appropriate, necessary types of food from domestic production, commercial imports or donors are continuously available to the individuals or are within reasonable proximity

to them or are within their reach. Food access means that individuals have adequate incomes or other resources to obtain levels of appropriate food needed to maintain consumption of an adequate nutrition level. Biomass may contribute to increased or reduced food security, depending on policies, agricultural systems, markets, prices and income level of the poorest. For instance an increase of food prices may be an opportunity for farmers due to increased income and thus to increased food access. On the other hand increased food prices may not be affordable for the poorest. Increased food prices especially affect food importing economies which are many Asian countries. The current impact of biomass on food security is still low, but may increase with increasing biomass demand.

Employment opportunities are associated with the growing global demand for bioenergy, thus leading to increased income generation and rural development. Employment increase is generally related to all steps of the value chain, from agricultural feedstock production, to the conversion process, and to the end use. In comparison to fossil fuels, the employment rate of biomass production is much higher. However, the positive or negative impacts on employment largely depend on the scale of the production systems. With increasing mechanization of agricultural production in many countries, and substitution of traditional agricultural systems, the number of agricultural jobs associated with the production of biomass is likely to decrease over time.

Rural development is seen as key for poverty reduction in Asia. Biomass production can

contribute positively to rural development, but this depends on the scale of the production and on the feedstock type. Land use is one of the most controversial subjects in developing countries since any land use change has positive and/or negative impacts. It is important to recognize in biomass projects that very often also so-called marginal land has value for the local population in Asia. In general, increasing biomass production will increase land use competition. An option to avoid land use conflicts is the improvement of agricultural productivity.

Land ownership systems in Asia are often associated with uncertainties, since land property is often not officially secured, and cadastral registries are often non-existent. Land is frequently leased from the state or held communally and is not based on private property. Therefore, land rights are regularly in dispute. Large scale production of feedstock is often criticized for depriving small farmers of their properties. Unclear land rights and poorly regulated land acquisition – conditions which often prevail in developing countries – may lead to displacement of local farmers to non-arable regions or urban centres. These concerns are basically the same if dedicated energy crops are grown for first or second-generation bioenergy production.

Agricultural transition from small-scale to large-scale farming is increasing and related to economies of scale. Usually the production of energy crops is more cost efficient on large-scale. This may lead to an agricultural transition from small to large-scale agriculture with extensive monocultures especially in industrial scale biomass projects. Insight is needed on the effects of this transition, especially on social impacts.

Risk mitigation of food production and income failure is an important issue for farmers, especially for smallholders and subsistence farmers. The risk consists on the one hand on market risks (e.g. sudden price fluctuations) and on the other hand on losses of harvests due to unfavourable climatic conditions or due to failure of agricultural practices. The main objective of smallholders and subsistence farmers is to produce enough food for their family's daily nutrition. Only if this is ensured, farmers will take care of other crops for income generation. As the example of cotton and peanut cultivation in India shows, it is very risky for farmers to concentrate only on one cash crop. The decrease of cotton and peanut prices pushed many farmers in exodus. The diversification of crops can contribute to reduce the agricultural risk and shall be considered in small to medium-scale biomass projects. Crops that have the ability to serve as food and fuel also reduce risks, since harvests can be sold either to the food or to the energy markets.

5. Biomass Cases in Some Asian Countries

A lot of program has been done in many Asian countries regarding biomass utilization. This proves that biomass is having the largest potential of energy sources for the future. The following table is the list of some Asian countries with its biomass programs.

Table 4. Biomass Case in Asian Countries

No.	*Country*	*Program*
1.	Japan	**Accelerate Biomass Town Plan** Promotion of utilization of unused biomass such as rice straws and forestry residues is a key issue for the plan.
2.	Indonesia	**Biomass from Palm oil wastes** Indonesia is the largest producer of palm oil, which gives big potency of biomass from its residues. Fauzianto in his study stated that biomass power potential from palm oil is estimated around 820 TJ on 2010 and Indonesia provides half of the world palm oil supply (2014).
3.	China	**Biomass production from agricultural and animal residues** With its wide area and numerous people, China has a big potency to use agricultural waste and animal residues as a biomass source. This non-plantation biomass sources can generate electricity to many rural people.
4.	India	**Biomass utilization by improving cookstoves** This is a community cooking stove, named as Earth Stove, and uses agro-waste briquette as fuel. Many schools and institutions in India provide meals for a large number of people and, use Liquefied Petroleum Gas (LPG) for cooking, which is currently subsidised by the Government. However, this subsidy is due to be phased out over the next five years and the cost of cooking by LPG is set to increase. Use of such type of community biomass stoves would save lot of funds for these institutions as waste briquettes are much heaper than LPG. It will allow use of a sustainable fuel (agro-waste), provide the briquetting industry with a more regular income, and generate income for the small farmers and labourers who will be involved in the supply chain.

6. Discussion

All these constraints and different perspectives allow us to formulate a simple conclusion: While biomass has a promising potential for energy production, the mentioned constraints, which might reduce the future potential and sustainability of biomass production, should also be taken into account. In the near and mid-term future, bioenergy will be the most important renewable energy type. Impact factors like land availability, water scarcity, biodiversity preservation and land degradation have often been excluded from potential estimates of global trends. Therefore, potential estimates of future bioenergy have varied widely. On the other hand, bioenergy from residual material and waste promises source based on biomass that does not compete with food and fodder production. The future use of biomass as an energy type needs a comprehensive assessment and will require careful management of natural land resources, such as soil and water. Unsustainable biomass use would disturb the climate-related advantage of bioenergy. The advantages of sustainable biomass production use should always outweigh the effect of its possible environmental damage. (*Ruppert et. al., 2013*)

So far, the transition towards renewable energy has been misunderstood as an economic demand and not as a means to gain diverse societal and economic advantages. Today, biomass could be produced to generate energy and renewable raw materials while simultaneously securing soil and water resources. The transition to a greener economy

is an important precondition to achieve the sustainable development of societies. Environmental and social costs are part of the economic system (including external environmental costs) and external diseconomies have to be taken into account when pursuing sustainable consumption and production.

In order to develop a modern and forward-looking energy supply from biomass, such as heat and power generation, there has to be a balance between the amount of biomass required for food production and for energy purposes. Production methods, crop types and conversion technologies need to be matched with local conditions within the different landscapes to establish a national transformation plan and to reduce the increasing land use competition between food/fodder production, bioenergy and forests. (*Vlosky & Smithhart, 2011*)

The significance of energy alternatives based on locally available renewable resources, such as biomass, is an important aspect of creating a new energy mix. At the same time, increasing the energy efficiency of the whole economy and all energy alternatives is an indispensable precondition for transitioning towards a renewable energy system and a society oriented towards sustainability.

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